Monitoring of fetal systolic time intervals as a parameter of hemodynamic changes in the fetal cardiovascular system sub partu.

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In this investigation the Pre-ejection-period (PEP) has been monitored as the most important systolic time interval.PEP is defined as the interval from the beginning of ventricular depolarization and onset of ventricular ejection. The PEP of the cardiac cycle, fetal heart rate (FHR), intrauterine pressure (IUP) and acid-base status were monitored in a series of more than 150 cases of unselected human fetuses in perinatal period. A new online technique using the fetal ECG and Doppler-ultrasound permits a continous registration of PEP patterns simultaneously with the fetal CTG sub partu. In addition relative PEP time was calculated from absolute PEP and duration of heart period.

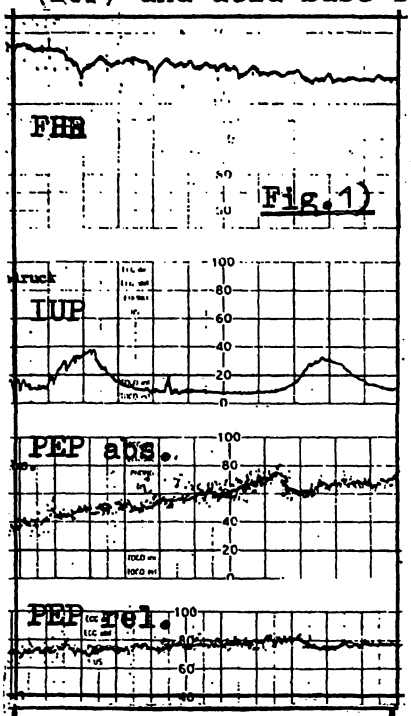

Fig. 1)

Results: Successful registrations of PEP were possible in about 95 % of all cases. By evaluation of the relative PEP it is possible to differentiate changes in PEP due to fetal heart rate alterations from those being hemodynamically effective. The normal rage of PEP under delivery is 65 to 80 msec. with a mean value of about 73 msec. Within this normal range and under steady state conditions the basic PEP is heart-frequency dependand in the majority of cases, that means, increases of the basic heart rate lead to the decline of actual basic PEP and worthwise, whereas the relative PEP remains constant. (Fig. 1). Actual basic PEP values below and beyond this normal range were registered in fetal acidosis and hypoxia as well as in states of severe placental insufficiency. Within the normal range of PEP, that means from 65 to 80 msec only pH values better than 7,3 and BE values better than - 3 have been registered. A decrease of myocardial contractility leading to a prolongation of the PEP during chronic acidosis possibly due to a derectely damage of the fetal myocardium. An abnormal shortening of the basic PEP due to an increase of myocardial contractility in acute hypoxia. This phenomenon can be explained by an increase of the catecholamine output in acute fetal distress situation.

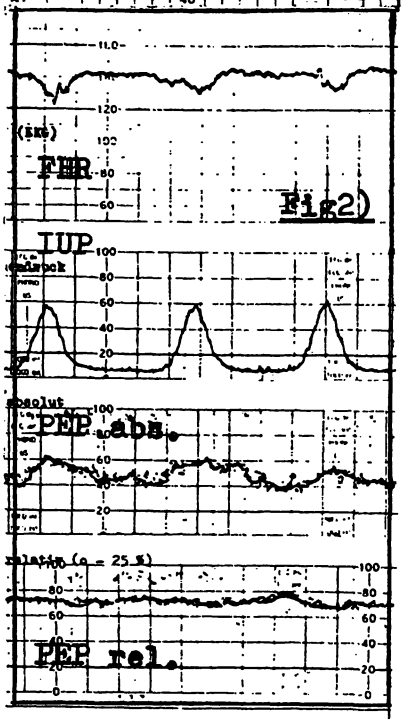

Fig. 2)

Fig. 2: During accelerations and decelerations of the fetal heart rate caused by fetal head compression and reflexly

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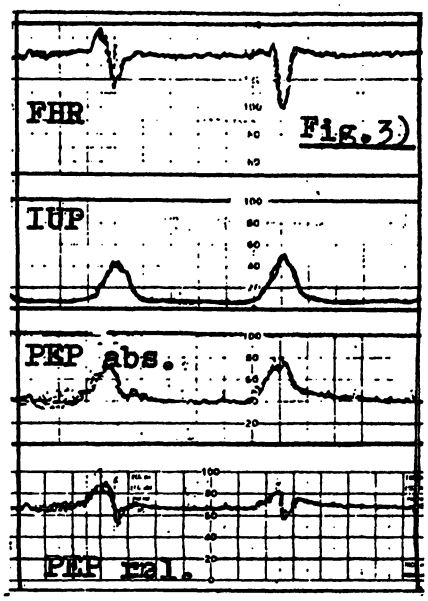

Fig. 3)

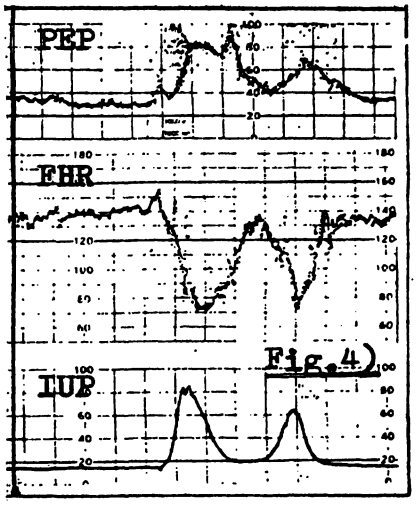

Fig. 4)

ethiology there is a monophasic prolongation of the absolute PEP time during decelerations and a monophasic shortening of the absolute PEP time during accelerations, while the relative PEP time remains constant. These changes are reflexly ethiology and due to changes in fetal heart rate, because the relative PEP time, that means the relation of the absolute PEP to the duration of the heart period remained constant.

Fig. 3: During heart frequency alterations caused by hemodynamic changes of fetal blood circulation there is an increase of absolute and relative PEP time. These changes therefore are heart frequency independand and they due to an increase of the diastolic pressure in the aorta during labour activities.

Fig. 4: During severe umbilical cord compression there is a double monophasic increase of the PEP. Whenever a double monophasic increase of the PEP has been observed 85 % of these fetuses had a umbilical cord complication. This double increase of the PEP has already been described by EVERS + de HAAN in chronic sheep experiments and this phenomenon only has been observed during umbilical cord compression with following hypoxia in poorly exygenized Lambs. The worse the oxygenation the shorter the distance between 1. and 2. step of PEP increase. The first step of increase can be explained with the sudden hemodynamic changes during umbilical cord occlusion, increase of afterload and decrease of preload. The second step may be due to a further increase of arterial blood pressure as a consequence of peripheral vasoconstriction induced by chemoreceptor reflexes.

Conclusion: Monitoring of the PEP parallel to the fetal CTG is a safe and easy applicable non invasive method and seems to allow to detect fetal acidosis and to destinguish decelerations only reflexly ethiology from those being hemodynamically effective, representing a slight or severe restriction of the feto-placental unit.

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